# Structuring General Information Specifications for Contracts in Accordance with the UNI 11337:2017 Standard


**Claudio Mirarchi, Sonia Lupica Spagnolo, Bruno Daniotti and Alberto Pavan**

**Abstract** Information Specifications are an important tool that allows the Customer or the Commissioning Body to define both the general and the specific rules and strategic information requirements, as well as the general guidelines for the formulation of the Pre-Contract BIM Execution Plan, by the Competitors, and then of the Contract BIM Execution Plan, by the Contractor. In Italy, in public contracts, the commissioning bodies "*can request for new works as well as for recovery or redevelopment interventions or variants, especially for complex jobs, the use of specific electronic methods and tools"* (Legislative Decree No. 50/2016, article 23, paragraph 13) "*such as modelling for building sector and infrastructures*" (Legislative Decree No. 50/2016, article 23, paragraph 1, letter h). These tools use interoperable platforms by means of open, non-proprietary formats (IFC, XML; etc.), in order not to limit competition between technology suppliers and involve specific projects among designers. The use of electronic methods and tools can only be requested from commissioning bodies equipped with suitably trained personnel. The subsequent implementing decree (Infrastructure and Transport, Ministerial Decree No. 560 of 12/01/2017) reaffirms this possibility in article 5 and introduces in article 6 a progressive obligation from 1 January 2019 for complex works depending on the tender amount (starting from $>= 100$ ml€). From 1 January 2025, the obligation will be extended to all tender amounts. The stringency of such methods and tools depends on the extent of the contract, but some Commissioning Bodies are moving towards applying them voluntarily. For this reason, research activity was conducted to test the possibility of defining the structure of the Standard General Information Specifications, drafted according to the UNI 11337-5-6: 2017, valid for contracts for the Inter-regional Superintendency for Public Works in the Lombardy and Emilia Romagna regions of the Ministry of Infrastructure and Transport. Starting from the analysis of works-only contracts based on the traditional, non-digital (non-BIM) design and through the validation of a case study.

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B. Daniotti et al. (eds.), *Digital Transformation of the Design, Construction and Management Processes of the Built Environment*, Research for Development,
https://doi.org/10.1007/978-3-030-33570-0_10

**Keywords** EIR · BEP · Public procurement · Information management · Interoperability · UNI 11337

## 1 Introduction

The definition of a Building Information Modelling (BIM) process requires the clear identification of the Client/Commissioning Body information requirements (BSI 2013; UNI 2017c; ISO 2018). Hence, for the purposes of the contract's information flow, in addition to the production of the legal and contractual documents (as mentioned in the tender notice), an assessment will also be conducted on the development of all "multidimensional object-oriented models", (Ministerial Decree No. 560 of 12/01/2017, article 4, paragraph 1), hereinafter: "graphic models" (UNI 2017a), necessary to fulfil the information requirements defined by the Client.

The Employer Information Requirement (EIR) allows the specification of the needs and information requirements of the Client/Commissioning Body for the execution of a public contract for works, supplies or services.

Through the Pre-Contract BIM Execution Plan (Pre-Contract BEP), it is possible to explain and provide specific information on the information management offered by the Competitors in response to the needs and in compliance with the requirements of the Client/Commissioning Body detailed in the EIR.

The following Contract BIM Execution Plan (Contract BEP) defines instead the (operational) planning of the information management to be implemented by the Contractor in response to the needs and in compliance with the requirements of the Client/Commissioning Body detailed in the EIR. Figure 1 presents the awarding process from the call up to the definition of the Contract BEP.

The EIR is of a supplementary nature, on purely informational issues, compared to the other tender documents and contracts.

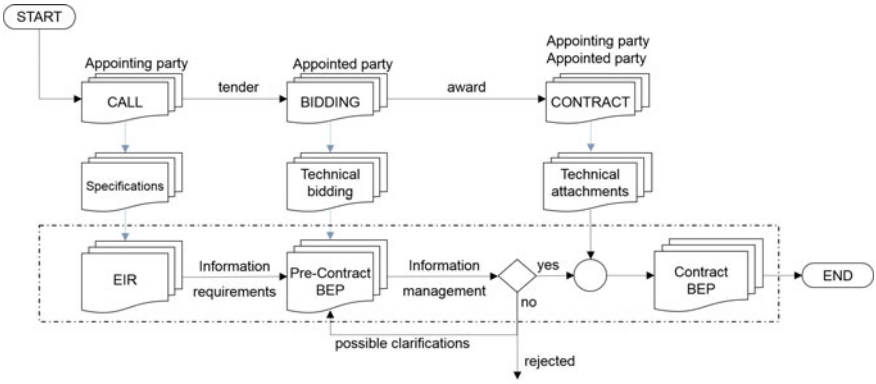


**Fig. 1** Award information flow

The EIR, the Pre-Contract BEP and the Contract BEP are contractual documents and may refer to the consensual UNI 11337:2017 standard (parts 1, 3, 4, 5 and 6) (UNI 2017a, b, c, d) for each technical principle.

The EIR devised stipulate that in the Pre-Contract BIM Execution Plan, and consequently in the Contract BIM Execution Plan, the Commissioning Body may require some direct prior experience in the use of *BIM methods and tools* deemed the most significant by the Competitor with regard to the specific intervention and stage of the process. The Pre-Contract BIM Execution Plan, and consequently the Contract BIM Execution Plan, must provide a specific section in which the hardware and software tools that the Successful Bidder intends to use for the following contract in the information modelling activities are explained. These two points are useful for the identification of the Competitors background helping the Client in the evaluation of their capability in performing the works.

For the Contract for which the EIR was drafted, the Client/Commissioning Body should provide the Contractor with specific digital sharing and collaboration spaces that are accessible via the Internet, for data storage, models and digital documentation. In general, these requirements are based on the definition of a Common Data Environment (CDE) that can be related to a Digital Platform for Works Management to promote the coordination of different works by the Commissioning Body. At the time of entering into the contract, the technical specifications and the rules of access to these digital spaces for sharing and collaboration will be defined.

In the Pre-Contract BIM Execution Plan, and consequently in the Contract BIM Execution Plan, other useful supplementary solutions may be proposed for the purpose of improving transparency, consistency and information management of the Contract for which it is drafted.

In addition to these general criteria, the EIR may contain several specifications defined according to the needs and the scope of each specific work. Nevertheless, the identification of a general structure can facilitate the understanding of the requirements from both the Client and the Competitors and promote the standardisation of the information flows in the Client organisation paving the way for the development of data analysis workflows.

## 2 Models Development and Coordination

In a BIM process, the term "model" can be interpreted according to different scales and may comprise the entire CDE or the single specialistic model. Thus, the development of building information models usually requires the coordination between several specialistic information models that must make reference at least to the following points:

– identification of the common system of reference coordinates;
– development of individual graphic models (UNI 2017a) for all the disciplines involved in the intervention;

– definition of an aggregate graphical model (UNI 2017a) of all the specialistic models;
– coordination and control of all specialistic models by the analysis of interferences (clash detection; (UNI 2017c)) and inconsistencies (code checking; (UNI 2017c));
– creation of information management rules for the contract (Pre-Contract BIM Execution Plan, Contract BIM Execution Plan and related documents) according to the needs and information requirements of the client explained in the EIR;
– creation and management of libraries of (digital) objects necessary for modelling (UNI 2017a);

In the Pre-Contract BIM Execution Plan, and consequently in the Contract BIM Execution Plan, other useful supplementary solutions may be proposed for the purpose of improving transparency, consistency and information management of the Contract.

## 3 Organization of Graphic Models

Without prejudice to any contrary overriding indication contained in the specific tender documents, for the purpose of information modelling, individual graphic models for each discipline involved in the intervention are required. The following list provide an example of possible specialistic models.

– urban planning and topography—GIS (including terrain modelling, urbanisations, underground utilities and contour viability);
– architecture (including finishes, access for disabled persons and fixed furnishings);
– structures (including steel structures);
– mechanical, plumbing, sanitary and air-conditioning installations;
– electrical installations (including production from renewable sources) and data;
– special installations (including, for example, vertical and horizontal transport, fire prevention systems, etc.);
– energy efficiency and acoustics;
– workers' operational safety (working stage).

In the Pre-Contract BIM Execution Plan, and consequently in the Contract BIM Execution Plan, the Competitors may propose a different organization of the models to optimise, e.g. the model dimensions, the collaboration workflows, the output organization, etc.

## 4 Specifications for the Use of Objects in Digital Models

In order for the graphic models to be developed by applying modelling criteria allowing them to be read, queried, and subsequently reworked easily, in all cases in which this is possible, the rules for a correct parameterisation of the elements by introducing the appropriate geometric constraints must be abided by. Below are some reference rules that exemplify the general principles described above with reference to the use of digital objects in the development of information models:

- all objects used in the graphic models should be associated with the natural level of localization (according to the specific discipline and regulations);
- all the vertical elements (walls, pillars, etc.) must be modelled as discrete elements in their vertical development according to a subdivision that is consistent with the decomposition of the Working Breakdown Structure (WBS) applied to the specific class of objects;
- all the structural elements are to be bound to the axes associated with them;
- all the plant machines positioned on the ceiling must be associated with the reference level of the discipline/underlying environment.

The definition of specific rules to develop the model allows easier control of the models and can limit the presence of data quality issues that can affect the effectiveness and efficiency of the entire process (Mirarchi and Pavan 2019).

## 5 Documentation

Without prejudice to any contrary overriding indication contained in the specific tender documents, the graphic documents must be extracted from their corresponding graphic models in case of information modelling. Representations of non-modelled knots and details are allowed solely for the purpose of completing the relevant information on the LOD (see the following sections) of some objects (where precise modelling is not necessary, in order to fulfil the objectives and uses of the envisaged model: safety, interferences, inconsistencies).

The MEP models must allow for extrapolation of both the real-scale representation of the elements (according to the reference LOD), comprising pipes and ducts, and the representation as a single-line diagram for the required set representations.

For non-graphic documents (UNI 2017a), each piece of data contained on or extractable from the models must be able to be extracted without any duplications.

The Contractor must ensure data consistency between the models and the documentation (graphs, documents, multimedia; (UNI 2017a)) of each discipline.

In any case, the Successful Bidder will have to ensure the coordination (and consistency) produced by the data for each document even though not extracted from models.

## 6 Data Sharing and Collaboration

The EIR must consider the processes and tools for data sharing and collaboration. Hence, it must contain the requirements related to the definition of the Common Data Environment (CDE) that should be provided by the Client/Commissioning Body according to the need of organising multiple works and promote standardised processes in its organization.

The Contractor shall deposit (uploading into the CDE) each graphic model and digital document concerning the specific work by the scheduled end of each level of processing/modelling laid down in the EIR. The uploading stages must be defined according to an information delivery plan that considers the verification and validation processes.

Thus, in order to ensure maximum efficiency in sharing the data, the following information must always be identifiable (according to UNI (2017b)):

– "*State of definition*" (L0; L1; L2; L3);
– "*State of approval*" (A0, L1, L2, L3).

The Contractor should specify in its Pre-Contract BIM Execution Plan how it intends to pursue this requirement even regardless of the CDE made available by the Client/Commissioning Body.

The modelling flow proposed in the EIR is synthesised in Figs. 2 and 3 with specific reference to the post-awarding phase (before the effective start of the works) and the works execution phase until the closeout (As-Built Work In Progress and Final As-Built).

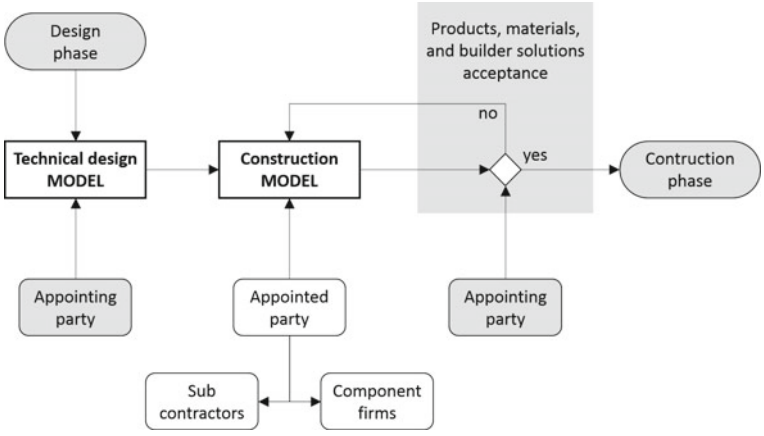


**Fig. 2** Modelling flow in the post-awarding phase before the start of the works

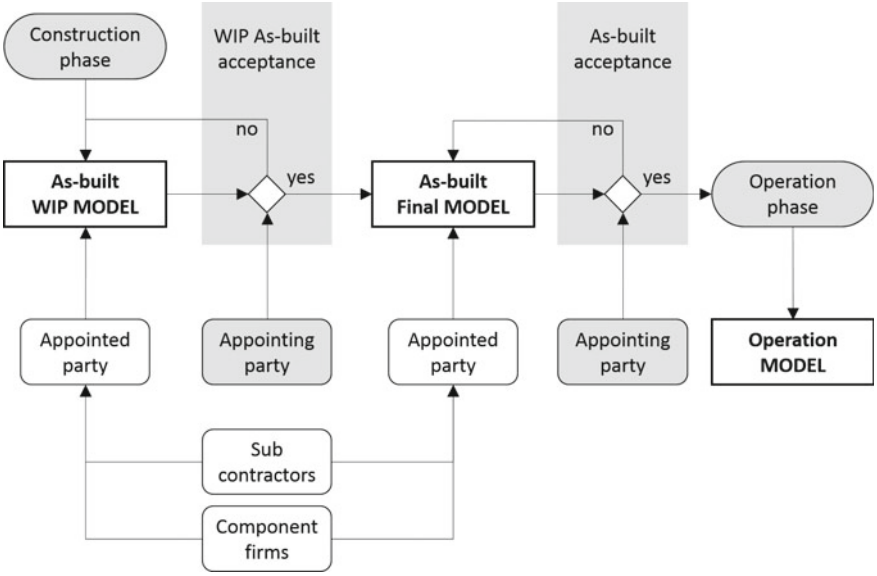


**Fig. 3** Modelling flow in the work execution phase until the closeout

## 7 Data Exchange Format

The BIM process should promote the use of open formats to avoid any limitation to the Competitors in the bidding phase. This principle must be applied to both digital models and documents. Digital documents should be in open pdf format or in other open formats such as xml, rtf, etc., depending on the specific document and its intended use. Information models must be shared using the IFC format (ISO 2013) defined according to the specific objectives and use of the model, i.e. according to specific Model View Definition (MVD).

Moreover, due to the intrinsic difficulty in modifying models and documents in open format, the Contractor should share also the native documents to facilitate the re-use of the models in the life cycle of the good.

Open and proprietary formats should always be coordinated and consistent.

## 8 Level of Development of Digital Objects

In the Pre-Contract BIM Execution Plan, and consequently in the Contract BIM Execution Plan, the LOD reference scale (Level of Development of Digital Objects; (UNI 2017b)) must be defined.

Each discipline will have to ensure that the level of development of digital objects/elements used in its document/model is aimed at achieving the objectives

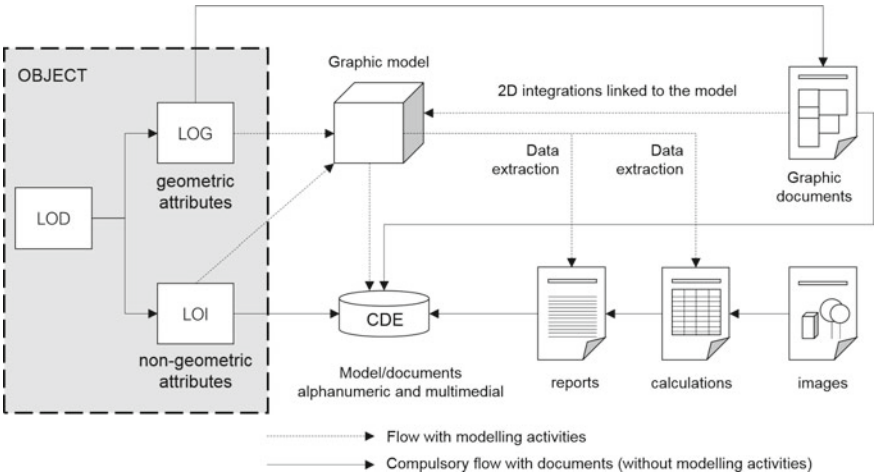


**Fig. 4** Diagram of LODs; geometric and non-geometric information attributes

defined by the law, set out in the EIR, or proposed by the Contractor, for the model/document itself. The minimum LOD of the objects/elements relating to each document/model will still have to meet every legal requirement for the phase of the process it relates.

The structure of the LOD[1] should guarantee the completeness and consistency of the information through the use of mutually interconnected graphic or geometric attributes (LOG; (UNI 2017b)) and non-graphic or informational ones (LOI; (UNI 2017b)). Figure 4 proposes an example of integration between objects, models and documents in the CDE highlighting the graphic and non-graphic nature of LOD).

As a matter of principle, we consider the following development levels of objects/elements as roughly consistent (those typical of the design level are in bold):

1. Survey:
   - LOD B-**F/G** (UNI 2017b);
   - LOD, LOI 2-**5/6** (BSI 2013; NBS 2015);
   - LOD 200-**500** ((BIMForum 2016) Part I and Part II).
2. Construction and Security:
   - LOD **E** ((UNI 2017b) paragraph 5 and annex I);
   - LOD, LOI **5** (BSI, 2013; NBS 2015);
   - LOD **400** ((BIMForum 2016) Part I and Part II).

[1]NB: the LOD of each digital object is made up of the geometric and non-geometric attributes defined in the model, in the graphic documents related to it, in the documentary (reports and calculations) or multimedia (images) texts, supplementary notes, jointly filed in the CDE and/or on the construction supervisor Digital Platform. This condition is valid provided that all the geometric and non-geometric attributes external to the graphic models are nevertheless unequivocally associated with the object or the objects for which the LOD is being assessed.

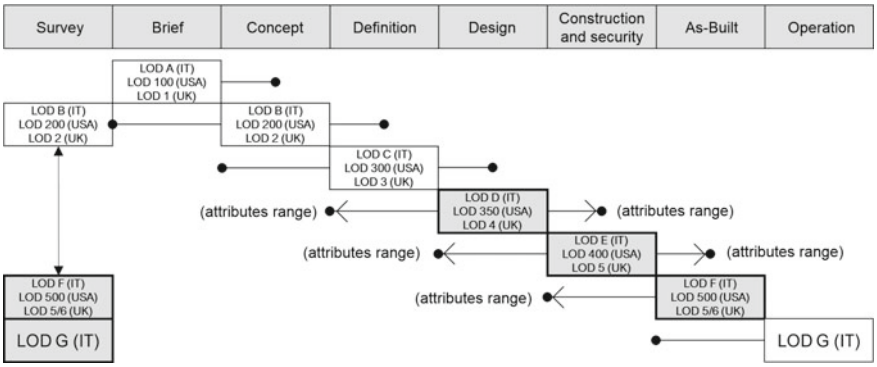


**Fig. 5** Comparative diagram of some LOD scales (national [IT] and international [USA and UK]) and definition range of the corresponding informational attributes in respect of the process stages of Italian public law

3. As-Built:

   – LOD **F** ((UNI 2017b) paragraph 5 and annex I);
   – LOD, LOI **5-6** (BSI 2013; NBS, 2015);
   – LOD **500** ((BIMForum 2016) Part I and Part II)

Figure 5 proposes a compared vision of the LOD scales according to UK, USA and Italian standards.

Some objects need to be defined according to both a 3D and a 2D graphic representation due to the need of transfer the technical information to the specialists. For example, digital objects representing the MEP devices must, in any event, contain the two-dimensional graphic representation as prescribed by the law (for example, the IEC symbols, UNI-CIG symbols, etc.).

## 9 Conclusion

This paper presents the research conducted in order to define a general structure of the Employer Information Requirements (EIR) for the Inter-regional Superintendency for Public Works in the Lombardy and Emilia Romagna regions of the Ministry of Infrastructure and Transport. In the light of the relevant state of the art at international level, as well as the regulations in force in the national context, a structure capable of being adapted to various types of contract has been developed, in such a way as to allow a standardisation of the same to optimise its use both by the Commissioning Body and by Competitors. Moreover, the identification of a general structure that can be adapted according to the specific works paves the way for the process standardisation of the Commissioning Body.

The specifications described herein have been validated on a first case study and this has allowed the Authors to fine-tune the specifications according to the real needs of both the Commissioning Body and the Competitors. Further application of the proposed structure by other Commissioning Bodies and/or in other works would enable a validation, also considering the potential peculiarities of other Public Clients.

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